PATENT SPECIFICATION (11) 1 546 785

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(21) Application No's 23474/75 (22) Filed 29 May 1975
23475/75

(23) Complete Specification Filed 27 May 1976

(44) Complete Specification published 31 May 1979

(51) INT. CL.[2] F16H 55/18

(52) Index at acceptance
F2Q 7A3H 7H1

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(19)

(54) MEANS FOR PREVENTING BACKLASH BETWEEN MESHED GEARS

(71) We, CHARLES WICKSTEED AND COMPANY LIMITED, a British company, of Stamford Road Works, Kettering, NN16 8YJ, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to means for preventing or removing backlash in gear assemblies.

More particularly, although not exclusively, the invention relates to means for preventing or moving radial backlash of a worm wheel and axial backlash of a worm shaft in engagement and transmitting a right angle driving force.

The invention can, with particular advantage, be applied to gear trains as set forth in the preceding paragraph for driving the cutting blade of a circular saw cutting machine for cutting thin section material where there may be less than two teeth of a saw blade in contact with a workpiece at any one time so that there is a danger of backlash.

In addition to preventing or removing backlash, the means of this invention will eliminate clearances between meshed gear teeth due to normal wear. A smoother and more vibration-free drive will also be obtained.

According to the present invention there is provided an assembly of meshed, first and second gears, wherein a third gear is provided directly or via other gears in meshing engagement with said second gear and mounted coaxially with said first gear to be freely rotatable relative thereto, wherein wedge means is provided biased by spring means to tend to move radially of the common axis of said first and third gears and engaging respective faces of said first and third gears on its opposite sides which faces are mutually convergent radially away from said common axis and both inclined with respect to a plane containing said axis so that the wedge means tends to counter-rotate said first and third gears so as to take up any play between said first and second gears.

Preferably the wedge means takes the form of a plurality of elements urged by respective coil springs to move radially outwardly of a hub portion of one of said first and third gears, each said element tapering radially outwardly of the common axis of said first and third gears and engaging on opposite sides thereof respective faces of the first and third gears. In this arrangement at least one said face engaged by each wedge element may be a flat on a body mounted on one of said first and third gears to be freely rotatable relative thereto about an axis parallel with said common axis.

Said second gear may be a toothed shaft and the first and second gears may be respectively a worm wheel and a worm shaft. In this arrangement the third gear may be a bevel worm wheel meshing with the worm shaft.

Alternatively the third gear may be a spur gear which meshes with a fourth gear, the fourth gear also being a spur gear fixed coaxially to a fifth gear for rotation therewith, the fifth gear being a second worm wheel engaging the worm shaft on the opposite side of the worm shaft to the first worm wheel, the worm wheels and the spur gears coaxial therewith being counter-rotatable about parallel axes perpendicular to the axis of the worm shaft.

To enable the invention to be clearly understood and readily carried into effect, two embodiments thereof will now be described by way of example with reference to the accompanying drawings, wherein:—

Figure 1 is a part-sectional view of a worm and worm wheel drive taken on the line I—I of Figure 2,

Figure 2 is a section taken on the line II—II of Figure 1,

Figure 3 is a part-sectional end elevation of an alternative gear construction taken on the line III—III of Figure 4,

Figure 4 is a part-sectional side view taken on the line IV—IV of Figure 3, and

Figure 5 is a section taken on the line V—V

of Figure 3.

Referring first to Figures 1 and 2 of the accompanying drawings, the gear illustrated comprises a worm wheel 10 and a co-axial bevel worm wheel 11 which both mesh with a worm shaft 21 and the means provided in accordance with this invention for preventing backlash comprises self-adjusting wedges 14 which are urged by coil springs 15 radially outwardly of a hub portion of the worm wheel 10 so as to act on faces of dogs 13 fixed to the worm wheel 10 so as to be free to turn about their axes, which are parallel with the common axis of the worm wheels 10 and 11, the wedges 14 acting on their opposite sides on faces of the bevel worm wheel 11, which is free to rotate on the same axis as the worm wheel 10 so as to tend to cause counter rotation of the worm wheels 10 and 11.

Since the worm wheel 10 is fixed to a drive shaft 16 by keys 12, and both the worm wheel 10 and bevel worm wheel 11 are engaged with the worm shaft 21, any rotary motion of the worm shaft 21 will induce relative right angular and reduced motion in the worm wheel 10 and the bevel worm wheel 11, and both components will thus rotate at the same speed and direction on the same axis, On assembly the worm wheel 10 and bevel worm wheel 11 are meshed with drive shaft 16 in a manner such that the wedges 14 are depressed on to springs 15 in order to provide maximum travel for the wedges 14 between the radially outwardly convergent faces of the worm wheels in operation.

During operation, the wedges 14 being urged by the springs 15 radially outward of the common axis of the worm wheels 10 and 11 causes the bevel worm wheel 11 to tend to rotate in anti-clockwise direction as viewed at Figure 1, due to force transmission at the faces 17 and 18 of the spring loaded wedges. This two directional rotation of this assembly will be halted when the teeth of worm wheel 10 come into contact with the opposite tooth faces of the worm shaft 21 as at 20.

The mechanism in this position eliminates all clearances and backlash that may have been present in the whole assembly, and subsequently wedges 14 will continue, due to constant pressure of springs 15 and wedging action of wedges 14 on faces 17 and 18, to remove any incurred wear or backlash due to any normal operational wear of the assembly. Also, the dogs 13, being free to rotate about their axes, will ensure a constant face contact of wedges 14 at said faces 17 and 18.

Referring now to Figures 3 to 5 of the accompanying drawings, the gear illustrated comprises worm wheels 30 and 39 both engaging a worm shaft 46, and a spur gear 31 free to rotate about the same axis as the worm wheel 30, said spur gear 31 meshing with a spur gear 46, the latter being fixed to the worm wheel 39 by means of captive screws 37 and dowels 38 so that the worm wheel 39 and spur gear 36 will rotate at the same speed in the same direction on the same axis.

The means provided by this invention for preventing backlash comprises self-adjusting wedges 34 which are urged radially outwardly of the common axis of gears 30 and 31 by springs 35 so as to act on faces of dogs 33 fixed by screws 32 to the body of the worm wheel 30, the wedges 34 acting in the opposite direction on faces 42 of the spur gear 31 so as to cause counter rotation of the worm wheel 30 and spur gear 31.

Since the worm wheel 30 and worm wheel 39 are both engaged with the worm shaft 46, any rotary motion of worm shaft 46 will induce counter-rotational right angle reduced motion of the worm wheels 30 and 39. As the worm wheel 39 has fixed to it the spur gear 36, both components will as already stated, rotate at the same speed and in the same direction on the same axis. The mechanism is assembled by meshing the spur gear 36 with the spur gear 31 in a manner such that wedges 34 depress springs 35 in order to provide maximum travel for wedges 34 when the mechanism is operational.

During operation, the wedges 34 being urged by the springs 35 radially outwardly from the common axis of gears 30 and 31 will cause the spur gear 31 to rotate in an anti-clockwise direction as viewed in Figure 3, and cause worm wheel 30 to rotate in a clockwise direction as viewed at Figure 3 due to force transmission of the spring-loaded wedges 34 at faces 41 and 42. This counter-rotation of the wheel 30 and gear 31 will be halted when the teeth of worm wheel 30 come into contact with worm shaft 46 at 43, and spur gear 31 continuing to rotate in an anti-clockwise direction transmitting the force through the meshing teeth of the spur gear 36 at point 44, thus rotating worm wheel 39 since spur gear 36 and whom wheel 39 are fixed, until the teeth of worm wheel 39 come into contact with the corresponding tooth faces of worm shaft 46 at 45.

The mechanism in this position eliminates all clearances and backlash that may otherwise have been present in the whole assembly, and subsequently, the wedges 34 will continue to remove any incurred wear or backlash due to any normal operational wear of the components of the assembly due to constant pressure of springs 35 and wedging action of wedges 34 between faces 41 and 42.

The use of spring-loaded wedges 14 or 34 provides a positive and infinitely variable self-adjusting action in the removal and elimination of clearance due to wear on any acting faces or any acting point or points within the assembly.

Although the invention has been described as applied to worm and worm-wheel assemblies it will be understood that it is applicable to

any arrangement of meshed gears where it is desired to take up any play or clearance between the interengaged teeth.

WHAT WE CLAIM IS:—

1. An assembly of meshed, first and second gears, wherein a third gear is provided directly or via other gears in meshing engagement with said second gear and mounted coaxially with said first gear to be freely rotatable relative thereto, wherein wedge means is provided biased by spring means to tend to move radially of the common axis of said first and third gears and engaging respective faces of said first and third gears on its opposite sides which faces are mutually convergent radially away from said common axis and both included with respect to a plane containing said axis, so that the wedge means tends to counter-rotate said first and third gears so as to take up any play between said first and second gears.

2. An assembly as claimed in claim 1, wherein the wedge means takes the form of a plurality of elements urged by respective coil springs to move radially outwardly of a hub portion of one of said first and third third gears, each said element tapering radially outwardly of the common axis of said first and third gears and engaging on opposite sides thereof respective faces of the first and third gears.

3. An assembly as claimed in claim 2, wherein at least one said face engaged by each wedge element is a flat on a body mounted on one of said first and third gears to be freely rotatable relative thereto about an axis parallel with said common axis.

4. An assembly as claimed in any preceding claim, wherein the said second gear is a toothed shaft.

5. An assembly as claimed in claim 4 wherein the first and second gears are respectively a worm wheel and a worm shaft.

6. An assembly as claimed in claim 5, wherein the third gear is a bevel worm wheel meshing with the worm shaft.

7. An assembly as claimed in claim 5, wherein the third gear is a spur gear which meshes with a fourth gear, the fourth gear also being a spur gear fixed coaxially to a fifth gear for rotation therewith, the fifth gear being a second worm wheel engaging the worm shaft on the opposite side of the worm shaft to the first worm wheel, the worm wheels and the spur gears coaxial therewith being counter-rotatable about parallel axes perpendicular to the axis of the worm shaft.

8. An assembly of meshed, first and second gears wherein means is provided for maintaining said gears constantly in engagement constructed and arranged substantially as hereinbefore described and as illustrated in Figures 1 and 2 or in Figures 3 to 5 of the accompanying drawings.

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Printed for Her Majesty's Stationery Office by MULTIPLEX techniques ltd., St Mary Cray, Kent. 1979. Published at the Patent Office, 25 Southampton Buildings, London WC2 1AY, from which copies may be obtained.

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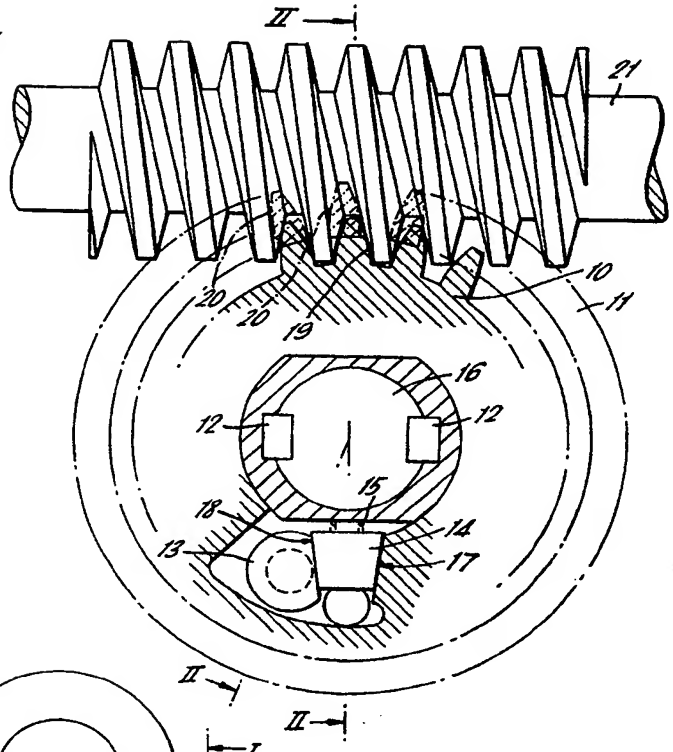
Sheet 1

FIG. 1.



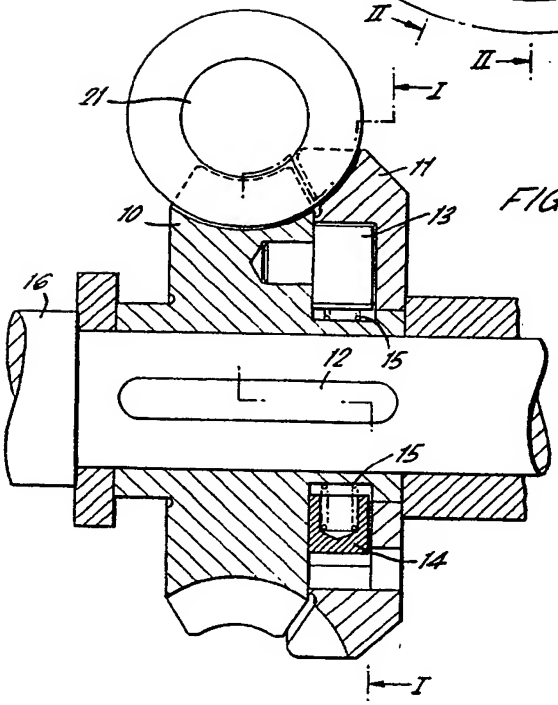
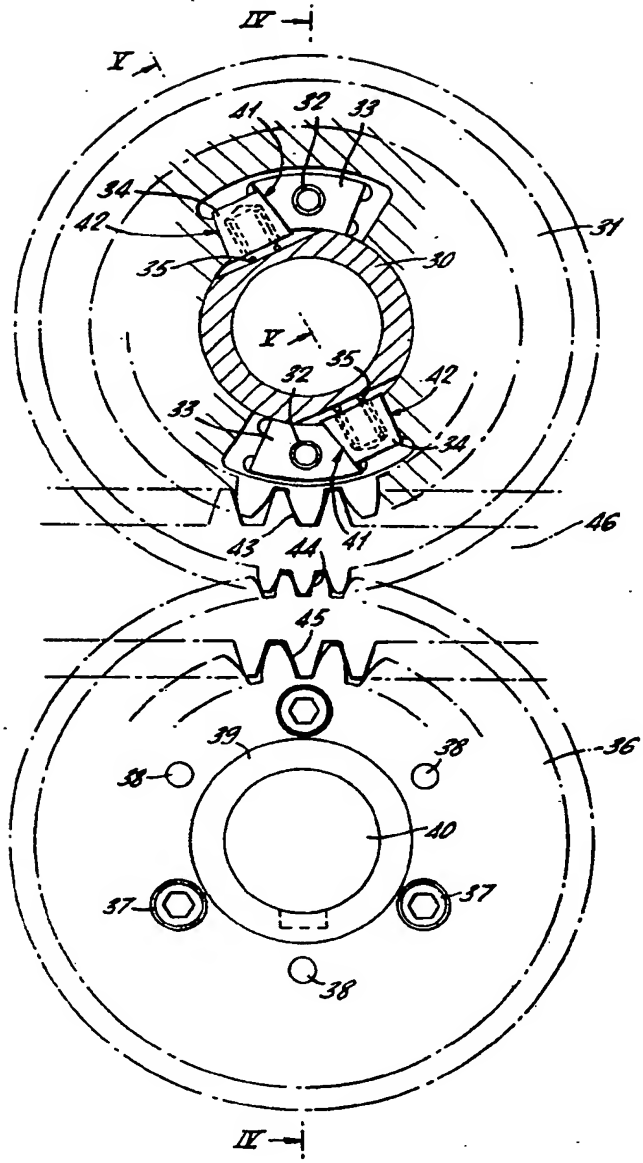


FIG. 2.

FIG.3



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Sheet 3

FIG. 4

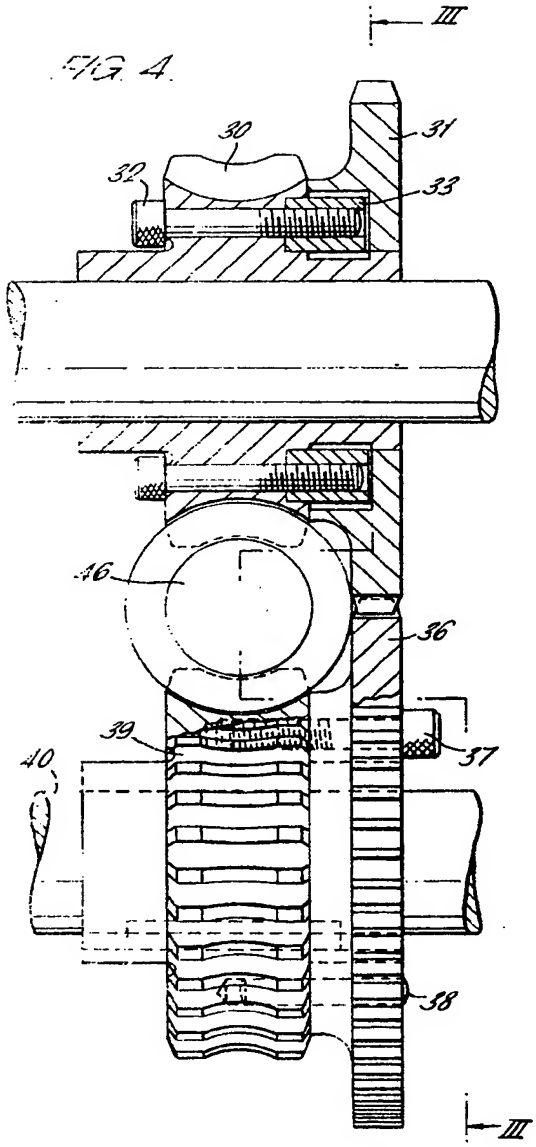

FIG. 5